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CURRENT COST/BENEFIT ASSESSMENT OF BOLL WEEVIL ERADICATION PROGRAMS IN TEXAS

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Abstract

A current cost/benefit analysis of the Texas program was conducted to evaluate the program's worth to Texas growers and state government officials. Alternative estimates of pre- and post-BWE yield savings and spray cost savings were obtained for seven different zones. Net present value and benefit/cost ratio calculations indicate that the seven BWE programs are a profitable grower investment in their entirety as well as (from a retention referendum perspective) from the present time forward.

Introduction

Background. The history, timing, and impacts of boll weevil (*Anthonomus grandis grandis Boh.)* in Texas are as varied as the considerably different production regions of the State. The Rio Grande basin and Gulf Coast regions were infested more than a hundred years ago. Boll weevil infestations were spreading from the Texas Rolling Plains to the Southern High Plains in the early 1960s, but were held at bay for decades by an area-wide diapause control program. However, boll weevil infestations on the High Plains were an established fact by the mid to late 1990s.

Since the mid-1990s, boll weevil eradication (BWE) programs have been in various stages of initiation or completion across Texas. Figure 1 shows twenty defined zones in Texas and New Mexico that are under the jurisdiction of the Texas Boll Weevil Eradication Foundation (TBWEF). There are currently active eradication programs in all of these zones except for the Northern Blacklands. The Texas program first began in 1994 in the Southern Rolling Plains (Zone 1). A cost/benefit analysis of the Texas program as it stands today in various zones would be a useful demonstration of the program's worth to Texas growers and state government officials. In particular, current state regulations require retention referenda every four years in zones with active eradication programs.

BWE Cost-Benefit Studies. There have been a number of published economic studies of BWE, most of which can be classified as either before or after-the-fact studies. The before-the-fact studies have many assumptions, and have typically been more aggregate in scope. A national USDA/university study predicted that BWE would increase yields, increase supply, and create some mild downward pressure on prices (Taylor et al., 1983). This study collected expert opinion of the impacts of BWE on cotton production through a Delphi process. In contrast, Smezdra et al. (1991) used crop simulation modeling to simulate BWE scenarios in the Mississippi Delta region. Applying stochastic dominance methods to these results, these authors concluded that BWE strategies were profitable and dominated other boll weevil management strategies among risk averse farmers. Extension economists in various states have conducted a number of unpublished *a priori* studies. For example, at the 1995 Texas/Oklahoma Boll Weevil Eradication Workshop, Robinson (1993) presented a before-the-fact study of BWE in the Texas Rolling Plains, which did incorporate price effects (which were so small that they were outweighed by the expected savings in BW spray costs). Similarly, Robinson and Vergara (1999) used expected savings in boll weevil yield losses and on-farm sprayings, net of possible increased plant bug control costs, to show that BWE in the Mississippi Delta region was still a profitable investment using the net present value criterion.

The published after-the-fact studies like Carlson et al. (1982) have been of particular regions of the U.S. These studies documented increased yields, decreased spraying costs, increased cotton acreage, and increased land values. These studies also conveniently assumed that their regions weren't big enough to create a supply response, so they ignored any price effects. Another regional *ex post* study of BWE, which included the Southern Rolling Plains of Texas (Johnson et al., 2001), found that in the seven years (1994-2000) it took to declare the boll weevil functionally eradicated, the costs exceeded the benefits in the first two years for a net loss to the producer before the benefits outweighed the costs (net gain) in each of the next five years. On the aggregate level for the entire zone at the end of the seven year period, the benefits were calculated to be $1.45 for every $1.00 cost incurred by the producer.

The purpose of this study was to conduct a current assessment of the rate of return on grower investment in BWE in Texas, as well as evaluate the profitability of further investment (i.e., continuing programs into the future). As such, this study is a blend of *ex post* impacts and *a priori* expectations.

Methods

Study Regions. Time constraints limited the scope of this study to seven major cotton regions in Texas where BWE programs either have reached the maintenance phase or are expected to do so within the next five years. The BWE zones evaluated in this study include the Southern Rolling Plains (Zone 1), the South Texas/Winter Garden (Zone 3), the Southern High Plains/Caprock (Zone 5), the Northern High Plains (Zone 6), the Western High Plains (Zone 7), the Northern Rolling Plains (Zone 9), and the Northwest Plains (Zone 10) as shown in Figure 1. All of these regions have a significant dryland acreage, which has implications for the confounding influence of dry weather on post-BWE yield impacts.

Data Collection. The initial step in conducting the cost benefit analysis was to collect secondary data for the seven zones under study. The secondary yield data consisted of county yield data collected by the USDA National Agricultural Statistics Service for both irrigated and non-irrigated cotton (USDA-NASS). The secondary cost data were obtained from Beltwide Cotton Conference Cotton Pest Loss Database concerning yearly costs and losses attributed to the boll weevil for certain regions in Texas (Cotton Pest Loss Database). Historical BWE program assessments, expected maintenance assessments, and payout schedules were obtained from the TBWEF (Patton, 2004).

Grower Panels. The secondary yield and spray cost savings data were used in grower meetings within the respective zones to facilitate data collection from the growers. These meetings were held in November-December, 2004. The participants were invited growers and consultants who were considered by Extension Entomologists as being knowledgeable and representative of different areas within the particular zone. A modified delphi process was used to elicit participant expectations of average yield and on-farm spray cost savings from BWE, with subjective weighting for dry, average, and above average rainfall during the growing season. In addition, other potential cost and revenue impacts from BWE were solicited, e.g., savings from precluded secondary pest problems, improvements in harvest turnout or grade, etc.

Calculations. With the data collected from the Beltwide Cotton Pest Loss Database on boll weevil spray applications per acre and cost per application, we averaged pre-BWE boll weevil spray applications cost per acre, subtracted annual post-BWE boll weevil spray costs per acre from the average pre-BWE spray costs per acre to get annual post-BWE savings in boll weevil spray costs per acre. Similarly we compared annual post-BWE yield loss percentages to an average of pre-BWE years to obtain average annual savings in yield loss percentage, which were multiplied by the average regional cotton yield to obtain average annual yield savings (Johnson et al, 2001). The latter values were multiplied by the state average cotton price for Texas (or a loan rate of 52 cents/lb, whichever was higher). Annual spray cost savings per acre, yield loss savings per acre, grower assessments per acre, and other cost changes per acre were used to calculate annual net cash flows, net present value of net cash flows, and benefit/cost ratios. The discount rate for the net present value and benefit/cost ratio calculations was 5% (Sassone and Schaffer, 1978).

The data used in calculations described above were collected from entomologists via the Cotton Pest Loss Database in the proceedings of the Beltwide Cotton Conferences and from grower meetings held in the zones as described previously. The same set of calculations were made using the yield and spray cost (and in some cases, other cost) impacts obtained from the grower panels. After comparing preliminary results using Beltwide loss estimates versus subjective grower estimates, there were very apparent differences in the results obtained the two data sources. In general, the yield impacts estimated with the published Cotton Pest Lost Database were five to ten times smaller than results obtained using grower panel data. Upon consultation with the entomologists that made the original Beltwide estimates, they speculated that their original boll weevil yield loss estimates were probably underestimated by not considering the lost “top crop” yield potential in wet years due to boll weevil damage. Therefore, with help from the entomologists, their estimates were adjusted to account for higher yield loss in wet years. We obtained adjustments from Extension Entomologists to revise the published Beltwide boll weevil yield loss percentages, increasing them in wet years by 25% for Zones 1 and 9 (Fuchs, 2005), 20% in Zones 5,6,7 & 10 (Leser, 2005), and 15% in Zone 3 (Parker, 2005; Parker and Huffman, 1997).

Results and Discussion

From the NASS county yield data, average yields for the ten-year period prior to the beginning of BWE and for the time period since BWE began were calculated for both irrigated and non-irrigated acres in each of the seven zones. These yields are shown by zone in Table 1. There was an increase in yields in the irrigated acres in every zone except Zone 6, the Northern High Plains. An increase in yield is what would be expected with a successful BWE program. However, the dryland acres suffered a yield reduction in the post BWE period in every zone except for Zone 3, the South Texas / Winter Garden. This yield reduction is attributed to droughty conditions coinciding with the post-BWE years (e.g., Johnson, 2001). The confounding of pre- and post-BWE yield comparisons is the major reason a standard damages approach using the NASS yield data was avoided in this study.

Table 2 shows the data collected and calculated for Zone 5, the Southern High Plains/Caprock. Down the left side of the table is the year, and across the top are the categories of cost and benefits as well as their sums. The costs are separated into two categories: "Grower Assessment" and "Other Costs/Charges". The grower assessment is the per acre amount paid by the producer to the Texas Boll Weevil Eradication Foundation for the program. The other costs and charges, which is a blank column in Table 2, would include any additional costs incurred by the producer as a result of BWE. One example is spray costs for other insect pests like stink bugs that might have been controlled by a blanket insecticide application prior to BWE. Other costs included in this category are calculated custom stripping, modeling, and ginning costs based on the yield loss savings at a price of $.14/acre as reported in the 2005 Districts 1 & 2 crop budget (Texas Crop and Livestock Budget, 2005). Also across the top of Table 2 are two categories of benefits: "BW Spray Cost Savings" and "Value of BW Yield Savings". The spray cost savings are simply the money saved by the producer by not having to spray for boll weevils, and the yield savings are the additional yield produced after the adoption of BWE multiplied by the appropriate cotton price as described in the Methods section. Net Cash Flow is then total benefits less total costs.

From the data in Table 2, net present value and benefit/cost ratio can be calculated which is shown for Zone 5 as $391.03 and 3.08, respectively. A positive net present value and a benefit/cost ratio of greater than one both signify a good investment. More specifically, the net present value indicates that receiving $391/acre in 2001 would be equivalent to receiving the net cash flow in Column 6. The net present value is an indicator of the increase in per acre land value, from a theoretical income stream perspective. The cost/benefit ratio can be interpreted to say that that for every dollar a grower pays into the program, $3.08 is received back, on average. Both of these measures take account of the time value of money. It should be noted, however, that if a higher discount rate were used, both summary measures, while still profitable, would be lower. The 5% discount rate used in this study assumed that growers were financing this program with their own equity, the highest expected return on their equity in another use being 5%.

Table 3 provides the net present value and the benefit/cost ratio for each zone under study. These values were calculated from information for their respective zone just as in Table 2. Each zone has a positive net present value and a benefit / cost ratio of greater than one. Therefore, BWE has proved a good investment in each zone. In other words, if the producers could go back in time and revote to institute BWE in their zone knowing then the results of this study, they would still want to vote in favor of the program.

The next question this study set out to answer was "Should the program be continued?" To answer this question, all the costs and benefits to date were neglected, and net present values and benefit/cost ratios were recalculated for the period from year 2005 to 2025. The figures are shown in Table 4. Again all the net present values are positive, and all the benefit/cost ratios were greater than one. Therefore, BWE should be continued in every zone under study.

As mentioned before, there were some discrepancies between the entomologist data and the grower data. The growers reported higher yield loss savings and additional costs that were not taken into account by the entomologists. The producers' savings are tied to a "high-end, high-input management" system for cotton production that has been able to evolve since BWE. The additional yield savings come from the ability to produce a "top crop" from longer-season varieties. Higher costs are involved in this system reported by the growers as a result of longer season management, including the application of defoliants and other harvest aids in the High Plains cotton. Because of this, the grower data are not presented here as they reflect a cost/benefit analysis of an entire production system involving the adoption of boll weevil eradication, chemical defoliation, green boll management, longer season management, and longer season varieties (including picker varieties). However, the collection of this grower data was essential in this study to highlight those years where the historical record of yield loss estimates by entomologists had likely been understated.

Although the financial calculations may vary depending on the BWE zone in the state and from whom the data is collected, BWE has proven to be a beneficial program and a worthy investment. Also, producers should vote to continue BWE from this point on at the next retention referendum. On another note, in further studies and future analyses, the use of available insect loss estimates may require adjustments.

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Figure 1. Texas Boll Weevil Eradication Zones 1, 3, 5, 6, 7, 9, 10

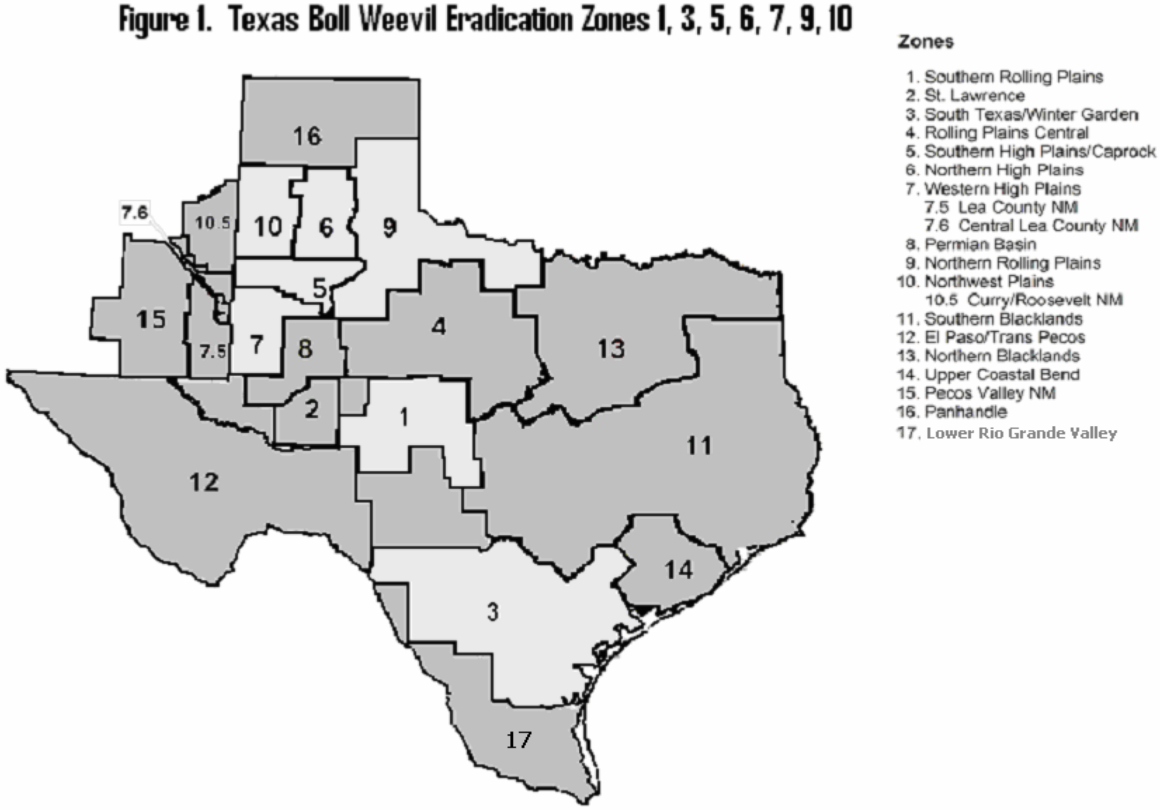

Table 1. Average Yields (lbs lint/acre) Before and After BWE for Selected BWE Zones.

Zone	Pre-BWE	Post-BWE
1 Irrigated	535.8	571.7
1 Dryland	266.8	245.3
3 Irrigated	782.8	987.4
3 Dryland	467.6	501.4
5 Irrigated	517.4	560.1
5 Dryland	284.5	227.2
6 Irrigated	575.9	681.4
6 Dryland	325.7	278.7
7 Irrigated	634.2	559.8
7 Dryland	312.5	227.7
9 Irrigated	480.6	583.7
9 Dryland	264.8	228.3
10 Irrigated	625.6	742.2
10 Dryland	341.5	325.8

Table 2. Representative Farm-Level Cash Flow and Summary Investment Values From Boll Weevil Eradication and Selected Longer Season Management Practices for All Cotton in TBWEF Zone 5, So. High Plains/Caprock (nominal dollars per acre).

		Grower Assessment*	Other Cost Changes	BW Spray Cost Savings	Value of BW Yield Savings	Grower's Net Cash Flow
	2001	$9.00	$7.11	$9.85	$26.41	$20.16
	2002	$9.00	$9.47	$9.93	$35.19	$26.65
	2003	$9.00	$7.72	$9.93	$31.84	$25.05
	2004	$9.00	$7.72	$9.93	$31.84	$25.05
	2005	$9.00	$7.88	$10.13	$31.84	$25.09
	2006	$9.00	$8.04	$10.33	$31.84	$25.13
payout	2007	$9.00	$8.20	$10.54	$31.84	$25.18
	2008	$3.00	$8.36	$10.75	$31.84	$31.23
	2009	$3.00	$8.53	$10.97	$31.84	$31.28
	2010	$3.00	$8.70	$11.19	$31.84	$31.32
	2011	$2.50	$8.87	$11.41	$31.84	$31.87
	2012	$2.00	$9.05	$11.64	$31.84	$32.42
	2013	$2.00	$9.23	$11.87	$31.84	$32.48
	2014	$2.00	$9.42	$12.11	$31.84	$32.53
	2015	$2.00	$9.61	$12.35	$31.84	$32.58
	2016	$2.00	$9.80	$12.60	$31.84	$32.64
	2017	$2.00	$9.99	$12.85	$31.84	$32.69
	2018	$2.00	$10.19	$13.11	$31.84	$32.75
	2019	$2.00	$10.40	$13.37	$31.84	$32.81
	2020	$2.00	$10.60	$13.64	$31.84	$32.87
	2021	$2.00	$10.82	$13.91	$31.84	$32.93
	2022	$2.00	$11.03	$14.19	$31.84	$32.99
	2023	$2.00	$11.25	$14.47	$31.84	$33.05
	2024	$2.00	$11.48	$14.76	$31.84	$33.12
	2025	$2.00	$11.71	$15.05	$31.84	$33.18
			Net Present Value:		**$391.03**	
			Benefit/Cost Ratio:		**3.08**	

Table 3. Summary BWE Investment Values Using Revised Beltwide Entomologist Estimates of Boll Weevil Yield Loss, Boll Weevil Spray Cost Savings and Other Cost Differences

	Zone 1	Zone 3	Zone 5	Zone 6	Zone 7	Zone 9	Zone 10
NPV*	$329	$474	$391	$602	$209	$262	$330
B/C ratio	2.64	1.82	3.08	3.16	2.55	2.39	2.83

*Net present value, in dollars per acre

Table 4. Summary Investment Values for Retention of Boll Weevil Eradication.

	Zone 1	Zone 3	Zone 5	Zone 6	Zone 7	Zone 9	Zone 10
NPV*	$351	$554	$376	$580	$267	$266	$398
B/C ratio	3.54	2.09	3.36	3.41	2.92	2.65	3.27

*Net present value, in dollars per acre